REMARKS

Claims 1-12 are in the application and stand rejected.

Claims 1-8 and 10-12 stand rejected under 35 U.S.C. §102(b) as being anticipated by O'Brien et al., U.S. 4,681,612 ("O'Brien"). The rejection is respectfully traversed.

O'Brien discloses a process for the separation of landfill or biogas which typically comprises greater than 90 mole % carbon dioxide and methane, and also small amounts of nitrogen, oxygen, hydrogen, carbon monoxide water vapor and aggregate "trade impurities". Total trade impurities is about 0.1 % (see col. 1, lines 10-18, and Table I, column "154"). The disclosed separation produces a high purity liquid carbon dioxide stream and a compressed fuel-grade methane product stream. The feed mixture, after hydrogen and water removal, is fractionated in a cryogenic distillation column from which are withdrawn a liquid carbon dioxide enriched bottom product containing most of the impurities and a methane enriched overhead gas stream. The overhead gas is further separated in a methane membrane purifier system to obtain a permeate carbon dioxide enriched stream that is recycled into the distillation column or the column feed stream. The membrane purifier also produces a retentate methane enriched product.

Although similar in many respects, the claimed process is different primarily in that the novel process employs <u>absorption</u> rather than <u>fractional distillation</u> to remove hydrocarbon compounds from the crude feed mixture and thereby produce a methane enriched intermediate product. Fractional distillation calls for boiling liquid mixtures of components to be separated

and condensing the vapors from the boiled mixtures in successive, normally vertically juxtaposed stages of a distillation column. A temperature gradient is maintained from higher temperatures low in the column to lower temperatures high in the column such that downward-flowing lower boiling temperature liquid mixtures contact upward-flowing vapors from higher boiling temperature liquid mixtures. Such operation produces mixtures having different component concentrations at each stage. Fractional distillation calls for the mixtures at each stage to be at the respective boiling temperatures defined by the concentration of the constituent components. As applied in O'Brien, the mixtures of methane, carbon dioxide and other components boil at relatively low temperatures in the range of -45°F at the top of the cryogenic recovery column (CRC) to 51°F at the bottom (see Table II columns labeled "178" and "176", respectively).

In contrast, absorption is a process in which a gas or liquid is taken up by a liquid or a solid. In the present invention gaseous hydrocarbon compounds of the feed mixture flow upward in the absorber and are contacted with descending liquid carbon dioxide absorbent. The liquid carbon dioxide absorbs the hydrocarbons and purges them with effluent from the bottom of the absorber. The absorber can be operated above the boiling point of methane which remains in the gaseous state and exits from the top of the absorber with some entrained carbon dioxide. Farther downstream in the membrane separators most of the entrained carbon dioxide is removed yielding a highly enriched methane product. The top of the absorber unit is maintained at temperature low enough to condense carbon dioxide. Thus as explained at page 8, lines 11-13, the temperature at the absorber top is as cool as about -5°C (+23°F).

According to this invention the top temperature is 68°F higher than that of O'Brien. Very importantly, the warmer top temperature of the absorber permits condensation of carbon dioxide gas absorbent recycled from the membrane separators to be performed with chilled brine or water rather than with a more expensive refrigerated coolant. In short, O'Brien operates the distillation is characterized as cryogenic (*i.e.*, very low temperature) unlike Applicants' novel process.

O'Brien apparently operates a cryogenic distillation process to achieve a high yield of useful carbon dioxide liquid as well as a potentially commercial value methane enriched product stream. This is evident by O'Brien's disclosure of an optional cryogenic purification column (CPC). Applicants here are largely concerned with producing a highly valued, highly enriched methane product. The membrane separators are effective to yield from the absorber intermediate product a sufficiently pure methane product stream. Because of the differences between the novel process and that of O'Brien, Applicants maintain that the claims are not anticipated and that the rejection should be withdrawn.

Claim 9 stands rejected under 35 U.S.C. §103(a) as being obvious over O'Brien in view of Burr US 4,793,841. This rejection is also respectfully traversed.

The Office Action concedes that O'Brien does not disclose the limitation of claim 9 calling for feeding the crude mixture to the absorption column below mid-height thereof. Burr is said to show such a feed location in Fig. 1. However, Burr like O'Brien involves cryogenic fractional distillation and not liquid absorption. Temperatures in the distillation column range from 260 °K (8°F) at the bottom to 180°K (-136°F) at

the top (col. 6, lines 9-10). Therefore, even the combination of Burr with O'Brien does not disclose the novel non-cryogenic liquid absorption-based process for refining crude natural gas.

For the foregoing reasons, Applicants respectfully request that the pending claims be allowed at this time.

Respectfully submitted,

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